

ART. IV. AFFINITIES OF *PHOEBIS RORATA COMSTOCKI*,
A NEW PIERID BUTTERFLY FROM JAMAICA

By A. AVINOFF

(PLATES I-III)

In the course of my studies of the lepidopterous fauna of Jamaica, British West Indies, I found that the local representative of *Phoebis argante* Hbn. requires a special description. The whole problem of the status of *Phoebis argante* is not completely clear. As far as the generic name is concerned, Mr. Martin Brown, who recently monographed the genus, is quite correct in using the term *Phoebis* for which in 1873 Butler designated as type the species *argante*. In this group of American Pierids the name of *Callidryas*, or *Catopsilia*, should be dropped, the latter being ascribable only to the cycle of related forms of the Old World. The generic name of *Aphrissa*, suggested by Butler for *statira* Cr. and its relatives, might be reserved for another cycle of Pierids of the New World which also appear in literature under the misused designations of *Callidryas* and *Catopsilia*, although the validity is questionable. It is not the intention of this paper to go thoroughly into all questions associated with *Phoebis argante* and its immediate relatives; the purpose being chiefly the correct identification of the Jamaican butterfly which appears in literature under this name. It seems desirable for clarity of exposition to survey a few salient facts concerning the distribution of forms belonging to this group, which has been so frequently misunderstood and misinterpreted.

Some entomologists like W. J. Kaye were misled so far as to consider *argante* conspecific with *agarithe* Bsd. Röber in Seitz' "Macrolepidoptera of the World" is also not inclined to recognize a specific distinction between the two. The reverse of the front wings indicates very clearly the obvious independence of the two species. The transverse series of maculae running from the apex to the inner border form a straight line in *agarithe* and show a broken arrangement in steps in the group of *argante*. The shrewdest of all lepidopterists on this subject, Butler, was quite correct in recognizing several related species within the cycle of *argante*. The differentiations which he has indicated in his "Lepidoptera Exotica" are well supported by distributional facts. The true *argante* in the male has a series of marginal black points at the end of the veins, as it is represented

in Hübner (Samm. Ex. Sch., I, Pl. 145, figs. 1, 2, 1806), in Lucas (Hist. Cuba Articulata, Pl. 15, figs. 4, 4a, 1856) and in Butler (Lep. Exot., 1874, Pl. 44, figs. 1-4).

The female is of the same bright orange color as the male, with a relatively unaccentuated black pattern along the margins of both wings and the discocellular of the primaries. The locality is indicated by Butler as "Brazil, Panama, and Honduras."

In the Carnegie Museum collection, typical *argante* with an orange yellow female is represented from Venezuela. To the same form should be assigned the variety with the bright yellow female, showing the orange tinge characteristic of the male and of the true *argante* female. The form *hersilia* Cr., which may be a separate species, has the same orange yellow female as *argante*, but has a more strongly developed black pattern which is especially prominent in the rich maculation of the underside. The male differs from *argante* in having the continuous black margin of the front wings and by the strong development of the pattern on the reverse. Butler indicates that the presence of two silvery spots on the reverse of the hind wings is a characteristic of *hersilia* as compared with *argante*. This cannot be taken as a completely diacritical mark since true *argante* males, with the marginal character reduced to a neural row of spots, may occasionally show a colored silvery pupillation of the mesial spot. The distribution of *hersilia* coincides with *argante* since it is found in Brazil, Cayenne, Peruvian Amazon, Nicaragua, and Ecuador. The Carnegie Museum has it from Peru, Brazil, and Bolivia. In the latter region both *argante* and *hersilia* occur in the same localities, a fact which leads some entomologists to accept them as morphs of the same species. According to Butler the female may vary from golden yellow to white with a slight rosy tinge. In the yellow-orange forms the difference between *argante* and *hersilia* seems to depend on the heaviness of the black pattern which is a characteristic variable within certain limits. It is probably impossible to establish an entirely fast dividing-line unless one has a series of males to be associated with such specimens, while females with a slight yellow flush on the margin of the hind wings could be ascribed to *hersilia* with certain reservations.

Catopsilia minuscula Butler (figured on Pl. 44, figs. 9, 10) is apparently a dwarfed specimen of the true *argante*, or one of its geographical forms, since size is the only characteristic of this diminutive form. It is a known fact that Pierids, more frequently than any other group of butterflies, at times produce underfed dwarfed specimens which may reach only half

the expansion of the normal type. The genus *Terias* is especially noted for such a propensity.

Catopsilia fornax, described by Butler from the female alone from a locality marked "Chile," probably an alleged or uncertain locality, is bright yellow with an intense red tinge on the hind wings and a rather heavy exterior suffusion of red scales on the front wings.

From the Isle of Pines a series was obtained by the collector of the Carnegie Museum which corresponds exactly with such females in Butler's "Lepidoptera Exotica," Pl. 39, figs. 5, 6. The male which was collected simultaneously with these females is of an *argante* type with mere black dots on the edge of the front wings. It is apparently a form close to the true *argante* and is characterized by the heavy red suffusion of the female.

The citation of Chile as the type locality of *fornax*, Coll. Kaden in Coll. Druce, is apparently wrong since a similar origin and the reference to the same Coll. of Kaden is also given for *solstitia* Btlr. There is no doubt that the latter butterfly is scarcely distinguishable from *avellaneda* Sch. Whatever might be the systematic status of *solstitia*, it is nothing but a form or a mere synonym of that Cuban butterfly. Thus there is scarcely any doubt that *fornax* also was originally obtained from Cuba. This contention is corroborated by a note of Bates, "Butterflies of Cuba," page 135, which mentions that Cornell University possesses a female of an insect almost exactly like Butler's figure of *fornax*, labelled "Cuba." This reference agrees with the material in the Carnegie Museum which contains three females of a typical *fornax* from the Isle of Pines. The males to be associated with this female are of an *argante* type. In this respect the monographer of this group of butterflies, Martin Brown, is in error in associating *fornax* with *philea*. The divergence of the group *philea* L. and *argante* is quite apparent in the females. The intense orange or Indian-red suffusion on the outer side of the hind wings is even and gradual, while in the forms of *rorata* this coloration is produced by an intensification of separate specks which gradually become confluent toward the border. *C. fornax* has this latter characteristic and on this ground alone should not have been associated with *philea*, as was done by Martin Brown.

The three specimens of *fornax* from Cuba which were very obligingly sent to me for study by the Museum of Comparative Zoölogy in Cambridge, are typical representatives of that form; two are not to be distinguished from the specimens from Nova Geron in the Carnegie Museum, and the third is of a far brighter brick red coloration than any of

the specimens from the Isle of Pines. One should scarcely expect, however, to find sufficient distinction between the main insular form and the representative from the smaller neighboring islands. The white female from the Island of Cuba is another matter. This specimen, preserved in the Museum of Comparative Zoölogy, and mentioned by Martin Brown, is actually a light form of the regular *argante*, and coincides completely with the females of that species from British Guiana. It is characterized by an underdevelopment of the marginal black pattern on the upper side and by a somewhat restricted dark pattern on the hind wings. The finding of a typical *argante* on Cuba is in itself quite unexpected. This solitary specimen bearing the label "Cuba, Wright" should be substantiated by other material since the attribution of the typical *argante* to the island hinges so far exclusively on this individual. If these distributional facts are valid it seems to prove that *argante* and *fornax* are two specific entities. The name *adela* of Martin Brown could not be given to the light specimen from Cuba since it is referable to the typical yellow female of the regular *rorata* Butler (the insular representative of *argante*). This, in itself, is a somewhat confusing statement in two points: it is not clear whether the specimen which Mr. Brown described is identical with the yellow forms of *argante* as found in Guatemala, or on which island of the West Indies this particular yellow female was found. The female from the island of Cuba in question certainly could scarcely be called yellow, although it possesses to a certain degree a yellowish tinge on its ground color. It fits much better among the whitish forms of the female of *argante* which Mr. Martin Brown designated under the name of *albante* without any indication as to the origin of the type. Even if *adela* is not a *nomen nudum*, it appears to be scarcely other than a synonym of *fornax*, as far as one can judge from a specimen of a female bearing a label in the writing of Mr. Brown, "*Phoebus argante rorata* f. *adela*," which is just a regular *fornax*. This individual, collected by Schaus and Barnes at Matanzas, Cuba, is preserved at the American Museum and was obligingly lent for study. Furthermore it is also not clear whether *albante* is suggested for the occasional white morphs of the female to be encountered among the tinted individuals, or whether such white females are a regional characteristic and constitute racial distinctions. The case of white females in the genus *Colias* indicates a wide range of variation in the taxonomic status of similar white females. In a number of examples of *Colias* with orange males, there may occur either exclusively orange females without a single known white form or an even proportion between

white and orange types, or else white females predominating to the almost complete exclusion of the orange ones; the ratio of the white females varying geographically. In this regard the examples of *Colias fieldi* Mén., *edusa* F., *myrmidone* Esp., *thysoa* Mén., *chrysotheme* Esp., *eogene* Feld., *aurora* Esp., and *diva* Gr. Gr., are very instructive. It may be that a more thorough study of the *Phoebis* of Central and South America, and of *argante* in particular, will furnish new data on the meaning and frequency of the white females, from the point of view of regional and taxonomic significance.

According to Brown and Barnes, *argante* and *hersilia* are the continental forms while *rorata* constitutes the insular representation in the Greater Antilles, having been originally described and figured from Haiti. *P. fornax* belongs apparently to the cycle of *rorata*. The butterfly from Jamaica belongs distinctly to that insular division of the *argante* complex. While males were recorded a long time ago, they did not give positive evidence of the systematic position of this form. Fortunately the capture of the female showed conclusively that this butterfly is a close relative of the Haitian *rorata*.

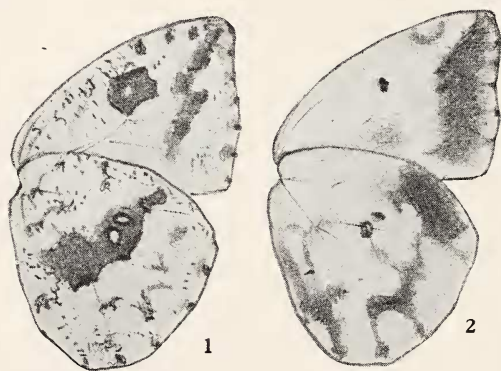
The form of *rorata* from Jamaica requires a special designation. The females are far more characteristic than the males which Kaye has obtained on this island. They were not only erroneously identified by him as *argante*, but he furthermore stated that *agarithe* is a dry season form of *argante* although according to his information it is to be taken in Jamaica in the wet season as well as in the dry!

***Phoebis rorata comstocki*, subsp. nov.**

Male: Bright orange-yellow with black marginal spots at the extremities of the veins. The marginal androconia are slightly lighter at a certain angle of illumination than the light orange color of the wings. The apex has a narrow black margin. The reverse is golden-yellow speckled with reddish brown with the usual marks of the *argante* group. The two red central maculae of the hind wings have a small center of mother-of-pearl scales or of pale pinkish scales without the mother-of-pearl lustre.

Female: Light straw-yellow with well defined marginal spots at the end of the veins of both wings, a black apex with an extension inwardly of a band with spots receding outwardly at the third radial vein. There are two costal black fuscous spots at the discocellular divided by the light straw-yellow vein. Both wings have an irroration of Indian-red speckles

which on the hind wings grow denser toward the outside and are slightly indicated at the base. On the front wings the irroration of Indian-red speckles is very slight, reduced to the area of the discocellular and the region toward the dark apex. The discus of the wing and the marginal portion show but very few reddish specks. The reverse is of a golden yellow color with brownish red, or a vinaceous pattern which is constituted by an interrupted band on the front wings from the apex toward the inner margin and is continued on the hind wings in a widening band through the mesian area containing the two usual silvery spots. The front wings have a large irregular discocellular patch with a lighter center of silvery scales. There is a general reticulation of the vinaceous dots and vermiculated lines with a certain intensification on the marginal ends of the veins and in the area of an irregular broken up band of the front wings and on the hind wings between the margin and the discal dark band. This race is named *comstocki* after W. P. Comstock of the American Museum of Natural History, New York City, noted for his studies of West Indian lepidoptera. The typical series comes from the vicinity of Bath (Hamp-ton Court and Balcarres) in the eastern part of Jamaica. Specimens were collected by A. Avinoff and N. Shoumatoff in the month of July on several occasions during their visits to the island between the years 1933 and 1940. The collection contains besides the type and allotype, eight para-types including seven males and one female.



FIGS. 1, 2. Underside of wing of *Phoebis rorata comstocki*, subsp. nov. The right figure (2) is a diagrammatic tracing in dark tone of the iridescent areas only.

This race of *rorata* is very close to the typical *rorata* of Haiti as figured by Butler on Pl. 44, figs. 5-8, of his "Lepidoptera Exotica," and as repre-

sented by characteristic specimens from Haiti in the Carnegie Museum. The differences are shown in the following table:

1. Both sexes of *comstocki* are slightly smaller than the Haitian form.
2. The male of the Jamaican form is slightly less brilliantly orange and tends more toward the golden yellow.
3. The androconia of the marginal part of the wings are still less orange in intensity of coloration, tending slightly toward the golden yellow.
4. The dark margin of the apex is more accentuated; the reverse is less profusely speckled with reddish brown.
5. The female has much less Indian-red irroration on the front wings, the discal part being mostly free from it, whereas in *rorata* this suffusion is quite marked.
6. On the hind wings the irroration of Indian-red is reduced toward the base and altogether not so abundant as in the Haitian form.
7. On the reverse the irroration of purple-brown is considerably reduced in both sexes as compared with the Haitian form and in the female this produces a much more contrasting effect of the bands and of the main pattern of maculations on the yellow ground color.

It is interesting to note that the new race belonging to the *argante* complex is found only in the extreme eastern part of the island while the territories to the west, starting with the vicinity of Spanish Town, are populated by *argante*. It appears, as far as present observations show, that the two habitats do not overlap. It is also of interest to observe that the Cuban region, including the Isle of Pines, is inhabited by a form of the *argante* group which diverges from the true *argante* in the direction of *rorata*, with a certain external likeness to *phileia*. The latter, however, always shows in the female a gradual tinting of the yellow background in the base toward the orange in the exterior part of the hind wings, and does not show any speckled pigmentation of red over yellow as in *foenax*. It should also be pointed out that all males of the Jamaican form have well developed silvery spots in the center of the reverse of the hind wings, which is but a rare occasional character in *argante* but a more constant one in *hersilia*. Martin Brown considers *argante* and *rorata* conspecific. He bases this opinion on the impossibility on anatomical grounds of distinguishing the two insects. The armature of both butterflies is practically the same but this point in itself is not sufficient for merging species especially in Pierids. The genus *Colias*, on this basis, should have a great number of its species fused into one systematic unit.

In the light of all these facts, the picture of the distribution of the forms is as follows: the continental forms split into two entities, one with the solid black edge of the forewings of the male in *hersilia*, the other with

this edge reduced to mere black points at the end of the veins in the monotypical *argante*. Whether these two forms are but morphs of a dimorphic species, or constitute a parallel distribution of two independent species, is a matter that cannot be definitely decided at present. In fact, it should be decided by rearing these forms in order to ascertain their identity or distinction. The insular representative of the group is *rorata*. Again, one cannot take a final stand on the specific differentiation of this butterfly as compared with *argante*. Butler, with all his analytical acumen, was tending toward recognizing too many distinct species in the group which was then at large called "*Catopsilia*." Seitz and his collaborators, on the opposite side, took the other extreme stand of "lumping" definite species into a collective unit. I am inclined to separate *rorata* from *argante*, even if there are no apparent anatomical differences. However, the structural distinctions of the distribution of androconia in the male, and the peculiar heaviness of the dark markings and the speckled distribution of the red irroration in the female, are sufficiently definite traits for specific distinction. The vicarious insular species of the continental entity may be called *rorata*, which may be one or two species depending on the taxonomic position of *hersilia* and the true *argante*. The record of an *argante* on Cuba requires further verification. The position of *rorata* is particularly interesting, however, since it indicates a certain leaning toward *philea*, which is an entirely distinct species in every respect, although it shows certain affinities with *rorata* in the pattern of the reverse and the characteristics of the coloration of the female. Another question that arises in this conjunction is the relationship of *philea* and *thalestris*. The Carnegie Museum collections contain examples of both butterflies from Haiti, but whether there exists an actual intergradation as between extreme forms of the same species or an occurrence of two species with an occasional hybridization is again a matter to be tested experimentally through rearing. It is noteworthy, nevertheless, that *thalestris*, as illustrated by Hübner and Butler, is a typical Antillean butterfly, and does not occur with *philea* in its continental habitats.

The Jamaican form of *rorata* acquires an independent and understandable position as an insular choromorph, or race, closely allied but not identical with the typical *rorata* of Haiti, and quite distinct from the Cuban *fornax* which belongs to the periphery of the same cycle.

An imperfect photograph of the reverse of the female has indicated some unusual characteristics of the pattern. This photograph was taken on process films without a filter which apparently, with the same in-

tensity, recorded the golden yellow of the background and of the markings which are thus completely lost in the uniform gray of the print. A new feature however emerged, this being a very faint bluish iridescence in certain parts of the exterior half of the wings. This iridescence covers both the yellow background and the dark markings in the fashion of an independent superimposed pattern emerging very clearly as an antemarginal band which is otherwise not noticed by the eye in the actual specimen. This light band has inwardly none of the broken outline of the dark pattern but runs as an evenly curved light antemarginal band with five small round neural dots which are not seen at all on the insect. On the hind wings appears an antemarginal band composed of a large macula in the upper corner following the dark irregular band which thus appears light and dark instead of being vinaceous brown on the light yellow background. This light line runs to the marginal part along the first radial and a light spot is visible in the next intraneural space inwardly. Thus the pattern gives a picture completely different from the actual aspect of the butterfly and shows the portions that are accentuated by bluish iridescence and by the ultra violet reflection. These characters, in slightly less pronounced form, are observable in a similar photograph of the other female of *comstocki*.

On the same photographic plate the reverse of the typical *rorata* female from Haiti does not show this peculiar distribution of bluish iridescence. The dark, broken transverse band spreading from the apex of the front wings is visible, the dark mesial band of the hind wings is also apparent, only the irregular dark markings between that band and the outer margin are obliterated by the presence of an iridescence which produces a uniform-tone effect in this area. Both forms from Haiti and Jamaica show six minute, iridescent, antemarginal dots on the front wings. They lie immediately inward as compared with the corresponding visible dark brown dots at the tips of the veins. It is a strange phenomenon to observe a complete similarity of the underside of the *rorata* from Haiti and of the form from Jamaica, which in photography shows an entirely different picture when taken on a plate susceptible to the recording of the iridescence and the neutralization of the straw-yellow tone of the background, and the purple-brown markings. In studying the characteristics of the iridescent pattern of *comstocki* from Jamaica, as compared with the visual properties of the pattern, one may describe the situation as the superposition of two patterns. These two patterns do not coincide so that either yellow or purple-brown pigmental scales may have or may not have the structural properties producing iridescence. The pattern, de-

pending on structural characteristics of the scales, should be considered at least of equal systematic importance with the pattern produced by pigmental variations. In this respect the divergence of the Haitian and Jamaican forms of *rorata* should not be minimized, although the two Jamaican females do not show the phenomenon in the same intensity. This incidental discovery has prompted some comparative studies of a variety of other representations of this genus, with the same photographic methods, and has disclosed the following results:

The iridescence on the reverse of the wings may be independent from the visible light and dark pattern on the background. This relationship in *Phoebis* may fall into four types:

1. No visible presence of iridescence at all, like *eubule* and *agarithe*.
2. A general spreading of light iridescence, as in *philea*.
3. An even antemarginal iridescence, apparent in both wings, without a definite inner boundary, as in *avellana*.
4. A specific iridescence as in *argante*, following the outline of the visible dark pattern only approximately and usually slightly dislocated inwardly.

In the case of the Jamaican *rorata* the iridescent pattern acquires the maximum divergence as compared with the visible part, while the Haitian *rorata* shows a more general suffusion of iridescence over the pattern which is thus obscured in its outlines through closer coincidence. The difference of the Jamaican and Haitian topomorphs is not very striking in this regard, so far as the available material shows, but it indicates these two divergent tendencies.

Since iridescence depends on structural properties of scales producing an interference of rays, and the color depends on pigmentation, it must be surmised that a different set of hereditary factors governs these two phenomena. Consequently the systematic and taxonomic importance of iridescence, as compared with the underlying visible pattern, should not be overlooked since it may lead to some interesting lines of comparative investigations.

EXPLANATION OF PLATE I

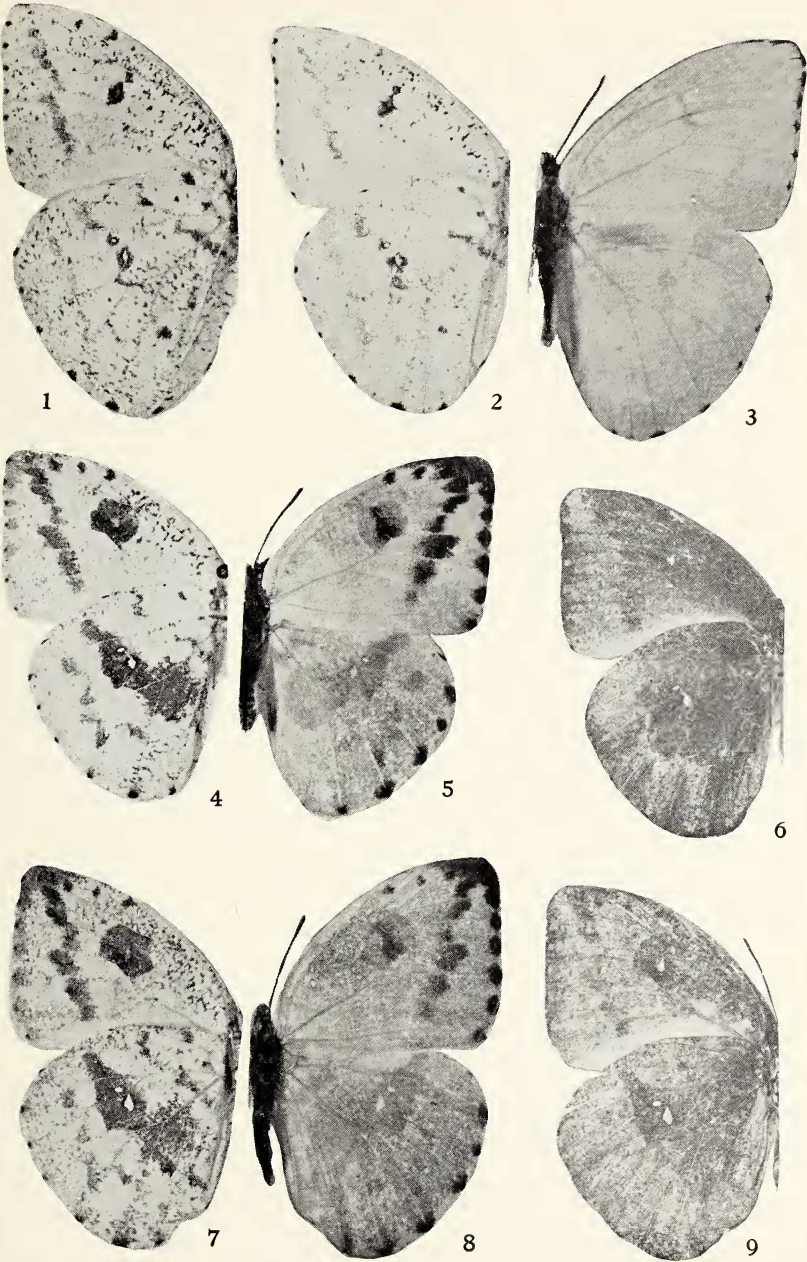
All specimens photographed on a panchromatic plate with the use of a yellow filter, except as indicated.

FIGS. 1, 7-9. *Phoebis rorata* Butler.
Specimens from Pétionville, Haiti.

- FIG. 1. ♂, underside.
FIG. 7. ♀, underside.
FIG. 8. ♀, upperside.
FIG. 9. ♀, underside, photographed without a filter.

FIGS. 2-6. *Phoebis rorata comstocki*, subsp. nov.

- FIG. 2. Type, ♂, underside, Bath, Jamaica.
FIG. 3. Type, ♂, upperside, Bath, Jamaica.
FIG. 4. Allotype, ♀, underside, Hampton Court, Jamaica.
FIG. 5. Allotype, ♀, upperside, Hampton Court, Jamaica.
FIG. 6. Allotype, ♀, underside, photographed without a filter.





American Pierid butterflies, photographed on a process plate without the use of a filter. A bluish iridescence and the ultra violet reflection accentuate a superimposed pattern in many of the forms.

Specimens in the collection of the Carnegie Museum.

- FIG. 1. *Phoebis thalestris* Ill., ♀, Haiti.
 FIG. 2. *Phoebis philea* L., ♀, Venezuela.
 FIG. 3. *Phoebis avellaneda* H. Sch., ♀, Santiago de Cuba.
 FIG. 4. *Phoebis fornax* Butler, ♀, Nueva Geron, Isle of Pines.
 FIG. 5. *Phoebis argante* F., ♀, Wismar, British Guiana.
 FIG. 6. *Phoebis hersilia* Cr., ♀, Buenavista, E. Bolivia.
 FIG. 7. *Phoebis hersilia* Cr., ♀, Buenavista, E. Bolivia.
 FIG. 8. *Phoebis argante* F., ♀, Guatemala.
 FIG. 9. *Phoebis rorala comstocki*, subsp. nov., ♀, Jamaica.
 FIG. 10. *Phoebis argante* F., ♀, Costa Rica.
 FIG. 11. *Phoebis argante* F., ♀, Venezuela.
 FIG. 12. *Phoebis argante* F., ♀, Guatemala.
 FIG. 13. *Phoebis sennae* L., ♀, Haiti.
 FIG. 14. *Phoebis agarithe* Bsd., ♀, Nassau, Bahamas.



American Pierid butterflies, photographed on a panchromatic plate with the use of a yellow filter. Specimens are the same ones shown on Plate II.

Specimens in the collection of the Carnegie Museum.

- FIG. 1. *Phoebis thalestris* Ill., ♀, Haiti.
 FIG. 2. *Phoebis philea* L., ♀, Venezuela.
 FIG. 3. *Phoebis avellaneda* H. Sch., ♀, Santiago de Cuba.
 FIG. 4. *Phoebis fornax* Butler, ♀, Nueva Geron, Isle of Pines.
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